Care of Farm Animals

Please note: Listed page numbers are relative to the 2008 GAAMPs and not the 2009 Draft

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BEEF CATTLE~~,~~ AND BISON ~~AND LLAMA~~

MANAGEMENT OVERVIEW

Because of similarities among production practices between beef cattle~~,~~ and bison ~~and llamas~~, Generally Accepted Agricultural and Management Practices (Practices) …artificial environments. When behavioral and physiological characteristics of cattle and bison are matched to local conditions, beef cattle thrive in virtually any natural environment in Michigan without artificial shelter. Protection, however, may be beneficial, especially for newborns, during adverse weather conditions. Cattle reside on pastures and woodlots, in small drylot facilities, in a variety of different types of feedlots, and in confinement. A complete discussion of proper care and management of beef cattle can be found at the web-site for National Cattlemen's Beef Association (see references).

MANAGEMENT PRACTICES

Nutrition: Feed and water… … following publications: Nutrient Requirements of Beef Cattle (National Research Council, 1984 or 1996),~~ Animal Breeding and Production of American Camelids (Escobar, 1984) and Buffalo Management and Marketing (1983)~~ Bison Breeders Handbook (National Bison Association, 2001) and Producer's Guide to Management and Marketing (Dowling, 1990). Avoid feed and water interruption that lasts longer than 24 hours.

Cattle may vary…energy balance. Cattle~~,~~ and bison ~~and llamas~~ should have frequent access to a source of water. When continuous… production of the animals.

Manure Management and Sanitation: Manure management should conform to the recommendations presented in the current Right to Farm Practices (Michigan Agriculture Commission).

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Animal Handling and Restraint: No edits in 1st Paragraph

Bison are less domesticated than cattle and require special handling facilities. Specific practices can be obtained from the National Buffalo Association (Jennings and Hebring, 1983) and the National Bison Association (Dowling, 1990).

Transportation: Safety and comfort…when the weather is changing rapidly. Water and feed should be readily available for long trips as described in Federal Regulations (the Transportation of Animals statute from the U.S. Code (49 USC Sec. 80502 Reference). More information on handling cattle can be found at Beef Quality Assurance web-site (see references).

RECOMMENDATIONS FOR THE ENVIRONMENT

Cattle on pasture… surrounding community. Cattle in back-grounding facilities or feedyards must be offered adequate space for comfort, socialization and environmental management. Periodic pen maintenance and cleaning are strongly encouraged. When muddy conditions exist, realistic intervention, such as addition of bedding, should be employed.

FACILITIES AND EQUIPMENT

Beef cattle…cattle can rest. Floors in housing facilities should be properly drained. Barns handling alleys should provide adequate traction to prevent injuries to animals and handlers. Additionally, handling alleys and pens should be free of sharp edges and protrusion to prevent injuries. Handling facilities should be designed to avoid impeding animal movement as much as possible. When handling the animals, excessive noise should be avoided. Hydraulic and mechanical equipment should be adjusted to the size of the animal to minimize injuries.

For additional information, see the Structures and Environment Handbook (Midwest Plan Service, 1987), Grandin, 1989, Boyles, et al. undated, and the Beef Housing and Equipment Handbook (Midwest Plan Service, 1995).

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HEALTH CARE AND MEDICAL PROCEDURES-No edits in first two paragraphs

Euthanasia: Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Methods can be physical or chemical and one of the approved methods recommended by the AVMA Panel on Euthanasia (AVMA, 2007).

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.

Non-Ambulatory (Downed) Cattle: A prompt diagnosis should be performed on non-ambulatory animals to determine whether extended care or euthanasia is recommended. Downed animals should be moved carefully to avoid compromising animal welfare. Acceptable methods of transporting downed animals include a sled, low-boy trailer, or in the bucket of a loader. Animals should not be "scooped" up into the bucket but gently rolled into the bucket and lifted. Dragging downed animals is unacceptable. Non-ambulatory animals must not be sent to a livestock market or to a processing facility.

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DAIRY

MANAGEMENT OVERVIEW

Michigan's female dairy cattle population consists of approximately ~~301,000~~ 335,000 mature dairy cows and ~~280,000~~ 330,000 calves and heifers. The remainder…pasture management systems.

MANAGEMENT PRACTICES

Management practices…by utilizing sound management practices (Raising Dairy Heifers for More Profit, 1987; Managing the Milking Herd for More Profit, Part I 1988; Carmel, D.K. 1996). Calves should be born in a clean, dry environment and receive an adequate amount (3-4 quarts) of quality colostrum soon after birth. Calves are normally removed from their mothers immediately or as soon as the calf's hair coat is dry. Calves remain much healthier when housed individually in a clean, properly ventilated environment (~~MWPS 2000~~ Dairy Freestall Housing and Equipment- MWPS #7. 2000; McFarland, D.F. 1996). Young calves…decrease in the winter.

Calves and Heifers: Calves are normally weaned when adequate intake of dry feed has been reached (NRC 2001). Weaned calves should have access to clean, fresh water and nutritionally adequate diets~~feed~~ to support an appropriate growth rate. Proper heifer growth can be achieved with varied management systems (Raising Dairy Heifers for More Profit, 1987, Bickert. W, and G. Atkeson. 1996). Heifer and intact male calves…maintain adequate growth.

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Heifers may be bred upon reaching an adequate size and weight (Raising Dairy Heifers For More Profit, 1987). Use of artificial insemination or natural service (bull) is an acceptable practice to breed heifers and/or cows.

Dry Cows: Cows benefit from a dry period prior to a subsequent lactation Restricting feed and water intake a few days prior to dry off are acceptable practices that will aid cessation of milk secretion and improve udder health (Managing the Dry Cow for More Profit, 1996)

Proper management…clean and dry. In addition, access to ~~a~~ good nutritional diets ~~program~~ that maintain~~s~~ appetite and feed intake should also be provided. Nutrition for the majority of dry cows should be a maintenance program according to NRC requirements (NRC 2001). Nutrition and housing needs will change 2-3 weeks prior to calving.

Lactating Cows: Nutrition programs…available at all times.

~~Cows benefit from a dry period prior to a subsequent lactation (Managing the Milking Herd for Profit). Restricting feed and water intake a few days prior to dry off are acceptable practices that will aid cessation of milk secretion and improve udder health.~~

~~Nutrition for the majority of dry cows should be a maintenance program according to NRC requirements (NRC 2001). Nutrition and housing needs will change 2-3 weeks prior to calving as outlined previously.~~

Animal Handling: Facilities designed specifically to handle dairy cattle for health checks or treatment, vaccinations, weighing, or hoof trimming and for handling bulls during hand mating will decrease risk of injury to cattle and people as well as reducing the stress of handling. All traffic areas should have non-skid surfaces that avoid causing excessive hoof wear. A number of restraint devices are acceptable, such as halters, hobbles, breeding chutes, squeeze chutes, headlocks, tables and stanchions. Restraint should be the minimum necessary to control the animal and ensure the safety of attendants. Proper design of the handling facility will facilitate animal movement.

TRANSPORTATION: Safety and comfort…are available (~~MWPS 2000~~Dairy Freestall Housing and Equipment- MWPS #7. 2000, Caring for Dairy Animals Reference Guide, 1994). Transport and handling stresses can be aggravated greatly by adverse or rapidly changing weather conditions.

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FACILITIES AND EQUIPMENT

Housing for calves…and resting (~~MWPS~~ Dairy Freestall Housing and Equipment - MWPS #7. 2000, Bickert, W., and R. Stowell. 1994, Planning Dairy Stall Barns NRAES/NDPC-37, 1988, Bickert. W, and G. Atkeson. 1996~~or Hoard's Dairyman's Plan Guide for Freestall Systems or Planning Dairy Stall Barns NRAES/NDPC-37~~). Calf housing systems …clean and dry.

Adequate housing…areas may need shade.

Feed bunks or…per animal should be provided (~~MWPS 2000~~ Dairy Freestall Housing and Equipment- MWPS #7. 2000).

Milking equipment…at milking (~~Milking System Design and Performance~~Western Regional Extension Publication No. 8, 1978.). To eliminate the…should be followed (~~USDA Handbook No. 696~~ Effects of Electrical Voltage/Current on Farm Animals. 1991).

~~ANIMAL HANDLING AND RESTRAINT~~

~~Facilities designed specifically to handle dairy cattle, including bulls for AI, hand mating, health checks or treatment, vaccinations, weighing, or hoof trimming will decrease risk of injury to cattle and people as well as reducing the stress of handling. All traffic areas should have non-skid surfaces that avoid causing excessive hoof wear. A number of restraint devices are acceptable, such as halters, hobbles, breeding chutes, squeeze chutes, headlocks, tables and stanchions. Restraint should be the minimum necessary to control the animal and ensure the safety of attendants. Proper design of the handling facility will facilitate animal movement.~~

HEALTH CARE AND MEDICAL PROCEDURES

Proper care of…to their herd. An ongoing preventive herd health program designed for each farm by the veterinarian and farmer will result in healthy cows. This includes a veterinarian designed vaccination program for cows, calves, and heifers. Management practices to reduce the risk of introduction and spread of infectious disease should be implemented. Health programs for heifers are designed to prevent disease and increase efficiency of growth. And a~~A~~ herd health program should include proper ~~ID~~ identification of all cattle and accurate records.

External and internal parasites need to be controlled. Pasturing may increase risk of internal parasites and will increase exposure to diseases carried by wild animals.

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~~Health programs for heifers are designed to prevent disease and increase efficiency of growth. Heifers should be vaccinated against diseases as deemed necessary by the herd veterinarian.~~

~~Health programs, including vaccinations for dairy cows, are an extension of the heifer program. External and internal parasites need to be controlled. Pasturing may increase risk of internal parasites and will increase exposure to diseases carried by wild animals. An ongoing preventive herd health program designed for each farm by the veterinarian and farmer will result in healthy cows.~~

Non-Ambulatory (Downed) Cattle: A prompt diagnosis should be performed on non-ambulatory animals to determine whether extended care or euthanasia is recommended. Downed animals should be moved carefully to avoid compromising animal welfare. Acceptable methods of transporting downed animals include a sled, low-boy trailer, or in the bucket of a loader. Animals should not be “scooped” up into the bucket but gently rolled. Dragging downed animals is unacceptable. Non-ambulatory animals must not be sent to a livestock market or to a processing facility.

Euthanasia: When necessary, humane euthanasia of animals should be carried out using methods as outlined in the American Veterinary Medical Association Guidelines For Euthanasia (AVMA Guidelines for Euthanasia. 2007)

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.

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EQUINE

MANAGEMENT OVERVIEW~~ AND HUSBANDRY SYSTEMS~~

MANAGEMENT PRACTICES ~~(INCLUDING TRANSPORTATION)~~

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Training: Horses in training…recognized equine association (e.g. ~~The American Horse Shows Association Rule Book 1994-1995~~ United States Equestrian Federation Rule Book, 2008, and American Quarter Horse Association Official Handbook, ~~1995~~2008) has developed and shall be in compliance with the Federal Horse Protection Act and Michigan cruelty to animals laws.

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Common fencing materials…bolts and latches. Single or double strand wire fences may lack visibility and have the potential for severe cuts to horses entangled in them. More visible products are available for wire fencing or large strips of plastic or cloth can be tied to wire to increase visibility. Fences should be approximately five feet…to minimize injuries due to kicking and fighting.

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A proper preventive vaccination program should be developed for individual horse needs. Effective vaccines are available to protect horses from fatal diseases including: ~~t~~Tetanus, ~~e~~Encephalomyelitis, West Nile Virus, and ~~r~~Rabies. The manufacturer's and/or veterinarian's recommendations should be followed for all vaccines.

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Euthanasia: When necessary, humane euthanasia of animals should be carried out using methods as outlined in the 2007 American Veterinary Medical Association Guidelines For Euthanasia.

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.

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PRIVATELY OWNED CERVIDAE
HEALTH CARE AND MEDICAL PROCEDURES

Euthanasia: Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Methods can be physical or chemical and one of the approved methods recommended by the AVMA Panel on Euthanasia (AVMA, 2007).

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.
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VEAL
HEALTH CARE AND MEDICAL PROCEDURES
Individual stalls for…replacements in groups after weaning.

Proper care of animals includes the establishment of a health program that emphasizes disease prevention. Veal farmers should establish a valid veterinarian/client/patient relationship with a licensed veterinarian to assist them in providing proper health care to their animals. An ongoing preventive health program designed for each farm by the veterinarian and farmer will result in healthy animals. This includes a veterinarian designed vaccination program. Management practices to reduce the risk of introduction and spread of infectious disease should be implemented. Preventive…veterinarian's recommendation. And a herd health program should include proper identification of all animals and accurate records.

Euthanasia: Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Methods can be physical or chemical and one of the approved methods recommended by the AVMA Panel on Euthanasia (AVMA, 2007).

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.

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AQUACULTURE SPECIES

MANAGEMENT OVERVIEW

Michigan aquaculturists…planting stock sales. In 2007, there were 60 registered farms in Michigan producing approximately $3,000,000 in aquaculture species. People involved in commercial game fish production or fee-fishing operations are required to obtain an aquaculture registration from the Michigan Department of Agriculture. Rearing of fishes for the aquarium trade in closed indoor systems is exempted from registration. People involved in production of fishes for stocking public waters shall also obtain a permit from the Michigan Department of Natural Resources and fishes must be certified free of specific diseases. MI complied

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laws and permit requirements for aquaculture and baitfish industries are summarized on the North Central Regional Aquaculture Center website. ~~Five firms produce over 50% of the approximately 1.65 million pounds (750,000 kg) of fish produced annually with a market value of approximately 2.5 million dollars.~~ . In addition to the Michigan game fish breeders, there are bait fish operators, a shrimp farm, and Koi and ~~a~~ carp farms. New Paragraph

Because of the… general in nature. More specific management practices for a wide variety of aquatic species can be found on the Aquaculture Network Information Center web page; however, modifications to the recommendations for use in other regions of the U.S. may be required for use in Michigan.

MANAGEMENT PRACTICES

Stock Procurement: An established list of approved species for aquaculture production is contained in the Michigan Aquaculture Development Act~~, Act 199 of 1996, as amended, 286.875, Section 5(2)~~. Only aquaculture species on the approved list are allowed for purposes of aquaculture production. Any movement, importing, or exporting of aquaculture species must be in compliance with the Animal Industry Act, 1988 PA 466, MCL Section 287.729a.

Aquaculture species should be obtained from a source with a history of freedom from disease. ~~Salmonids of all life stages~~ Live fishes obtained from an out-of-state hatchery must be certified as being free of certain diseases which are summarized on the North Central Regional Aquaculture Center web site.

Newly acquired aquaculture…no obvious abrasions or lesions.

For fish, opercula…cannibalism in some species.

~~It is illegal to import and stock grass carp or white amur (Ctenopharyngodon idellum), Japanese weatherfish (Misgurnus anguillicadatus), ide (Leuciscus idus), rudd (Scardinius erythrophthalmus), bitterling (Rhodeus sericeus), and tench (Tinca tinca) into Michigan without permission from the Director of the MDNR.~~

New Chapter-Camelids
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GENERALLY ACCEPTED AGRICULTURAL MANAGEMENT PRACTICES FOR SOUTH AMERICAN CAMELIDS

MANAGEMENT OVERVIEW

The Camelidae family consists of camels from Africa and Asia (Bactrian and Arabian) and those from South America (llamas, vicunas, alpacas and guanacos). Llamas and alpacas make up the domestic population of camels owned in the United States. Llamas are most popular with fewer alpacas. Vicunas and guanacos are not as tame and considered less adaptable to domestic environments. Llamas and alpacas are used as pack animals, for producing textiles and clothing from their wool, as guard animals for sheep and goats, as companion animals, and in rare cases for meat and milk products. Unlike our common species of farm livestock, information on the biological needs, breeding, genetics, behavior, nutrition and health management of camelids has not been studied as extensively.

Llamas and alpacas can be kept in conditions similar to cattle. They thrive more under natural conditions such as pasture, range and well-managed dry lots, compared to confined areas such as stalls. They are ruminants like cattle, sheep and goats but walk on foot pads rather than hooves. Llamas and alpacas can be thrifty and have water conservation capability under dry conditions. They are considered medium sized animals with males being larger than females at maturity. Llamas are the largest of the South American camelids with males weighing up to 300 pounds. Alpacas are smaller and weigh up to 175 pounds. Both are considered docile animals with temperaments suited for domestic conditions. They may spit when threatened or provoked and can be protective of their offspring (cria).

MANAGEMENT PRACTICES

Nutrition: Llamas and alpacas are three stomached animals. They ruminate and chew cud like cattle, sheep and goats. They are efficient foragers and browsers. Alpacas have similar nutritional needs as llamas except are better browsers than grazers. Both can be fed grain concentrates to provide supplemental energy or protein. Grass or legume hays or grazing on quality pasture are excellent sources of roughage and general nutrition. Protein requirements for these camelids are lower than for common species of domestic livestock and range from 10 to 16 percent depending on stage of development or physiological state such as gestation and lactation (see NRC, 2007). As with other domestic livestock, water should be potable and easily accessible whether supplied from natural streams or ponds or artificial means such as buckets, troughs or

automatic devices. Troughs, buckets or other containers should be regularly cleaned. If animals are pastured, forage should be suitable for grazing and free of poisonous plants. Plants considered toxic to common livestock are also toxic to llamas and alpacas. Concentrate feeds or simple grains used for feeding other ruminant livestock are suitable for feeding llamas and alpacas. Texturized feeds such as steam rolled corn and barley mixed with soy pellets rather than a fully pelleted ration are preferred and result in less choking and compaction. Supplementation with mineral mix and salt is recommended. In selenium deficient areas supplementation with selenium is recommended along with vitamin E. Good quality hay free of molds and spoilage can be fed in round or square bales. The use of body condition scoring can assist in determining nutritional status of camelids. A body condition score of 3 (1 – 5 scale) or 6 (1 - 10), with 1 being thin and 3 or 6 as obese, is considered to be ideal. Monitoring of the body condition is recommended for females during pregnancy and lactation, cria during growth and all animals during the winter months.

Reproduction: Camelids are different from large livestock in reproductive traits. They are induced ovulators and behaviorally receptive to breeding throughout the year. Breeding occurs while the female is lying down. The normal length of camelid gestation is 335 to 365 days. The use of pasture and pen breeding is most common and an acceptable strategy. Consideration should be given to time of breeding with respect to season and average daily temperature at the time of birth. Winter births require close management of mother and young and can be difficult for the cria. Shelter should be provided for winter birthing and periods of inclement weather. Keeping the cria warm and vigilance with respect to energy intake is important to managing winter births.

Handling: The llama and alpaca are a social herd-dwelling prey animal. They respond best to calm, slow and quiet handling. They are smart and instinctual animals and if they perceive danger they will take flight. Social order is kept through maintenance of a social hierarchy. Pregnant females or females with nursing young can be temperamental and protective. Intact males may show dominance and require more experienced handlers. Understanding the natural behavior of llamas and alpacas will help avoid injury to animals and human handlers. Llamas and alpacas can be halter broken and led. Halters should be adjusted so nose bands ride in the middle of the nose. Low riding nosebands may cut off breathing.

When loose, llamas and alpacas can be herded as a group. Llamas and alpacas may panic if separated from herdmates. Unless specifically trained to calmly accept well-trained stock dogs, the use of dogs to herd llamas or alpacas is not recommended. Restraining chutes or stocks that are adjusted to accommodate size and body shape work well for conducting preventative or therapeutic health

procedures or standard care practices such as nail trimming. Depending on size, docility and training, many common care procedures can be carried out with minimal restraint.

Transportation: Llamas and alpacas can be conditioned to ride in a variety of transport vehicles including trucks and trailers designed for livestock or vans that have been properly prepared for the animal and avoid injury or interference with the driver. Safety and comfort should be of primary importance in the transport of llamas or alpacas. Llamas and alpacas can be loaded loose into a transport vehicle or led by halter and loaded. Larger animals can walk or lightly jump into the transport vehicle. Small adult or young llamas or alpacas can be carried into the vehicle. Principles of calm and quiet handling are important to low stress transport. Llamas and alpacas tend to lie down during transport and should not be tied inside the vehicle. Space allotment should sufficiently accommodate lying down, resting posture and standing-up without struggle or seriously impacting an adjacent animal if more than one animal is being transported. Attention to weather conditions such as high heat or extreme cold, vehicle ventilation and animal coat condition (wool or sheared) are important to avoiding heat or cold stress. Seriously debilitated or non-ambulatory animals should not be transported unless they can be appropriately accommodated with out further injury or distress and the purpose of transport is to obtain medical care.

RECOMMENDATIONS FOR THE ENVIRONMENT

Alpaca and llamas are known as being tidy. They tend to defecate in specific areas away from grazing and feeding areas. In barn situations manure should be managed to prevent significant build up or wet areas. Areas should be kept bedded and dry within covered facilities. Pastures should be managed to maintain forage base (if principle source of nutrition) and minimize parasite loads. A general rule of thumb for stocking rate on a good quality pasture is 2 – 3 llamas or 4-5 alpacas per 2 acres. Dry lots should be of sufficient size and well drained to avoid mud conditions during rainy periods. Protection of surface waters and conservation practices to minimize soil erosion is part of good environmental stewardship. As with any livestock operation good hygiene and adherence to with local, state (Michigan GAAMPs) and federal guidelines and requirements is important to maintaining good community relations.

FACILITIES AND EQUIPMENT

Shelter: Llamas and alpacas are suited to outdoor and semi-confined housing systems such as three-sided sheds and barns of various configurations. As wool bearing animals, special attention to hot conditions and the mitigation of heat stress through shearing and/or the provision of shade from natural or constructed

shelter is recommended. Alpacas are especially hardy and adapted to cold weather conditions under normal cold conditions and under good care. For animals housed outdoors, natural shelter belts or artificial shelters should be available for relief during extreme cold or inclement conditions. Crias are more susceptible to cold stress for a week after birth and should be sheltered during this period.

Fencing: Exterior fencing should be higher than fencing used for common domestic livestock. Deer fencing or custom constructed livestock fencing with heights sufficient to prevent escape or entrapment are strongly recommended.

HEALTH CARE AND MEDICAL PROCEDURES

Health care programs for llamas and alpacas include addressing nutritional requirements, preventative health care measures such as vaccinations, parasite control, foot care, and emergency procedures in case of injury or illness as appropriate to local conditions. All animals should be observed daily for signs of illness, injury or abnormal behavior. Procedures requiring invasion of the body cavity (like castration) or that result in pain or distress should be carried out by a veterinarian or properly trained and experienced individual. Assistance of a veterinarian in developing a health care program is strongly recommended.

Euthanasia: Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Methods can be physical or chemical and one of the approved methods recommended by the AVMA Panel on Euthanasia (AVMA, 2007).

Dead Animal Disposal: Animal tissue, whole carcasses or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 66, Public Acts of 2005, July 7, 2005.

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New Chapter-Bees
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GENERALLY ACCEPTED AGRICULTURAL AND MANAGEMENT PRACTICES FOR BEEKEEPING AND APIARY MANAGEMENT

MANAGEMENT OVERVIEW

Due to their large numbers, easy transportation, and special adaptation for efficient foraging (e.g. dance language), European honey bees (Apis mellifera L.) play a critical role in Michigan and US agriculture. The value of the primary fruit and vegetable crops in Michigan that depend on pollination was approximately $422 million in 2005. Inadequate pollination of fruit and vegetables results in greatly diminished yields and reduced quality (McGregor, 1976). At least 60 of Michigan's important fruit and vegetable crops (including apple, blueberry, cherry, cucumber, and pumpkins) rely on honey bee pollination. Without honey bees to supply pollination services, much of Michigan's rich fruit and vegetable production would not be possible, and producers would be forced out of business. In short, Michigan's agricultural industry would be devastated. Nationally, the value attributed to honey bee pollination is estimated to be $14.6 billion per year (Morse and Calderone, 2000).

Despite the importance of honey bees, the beekeeping industry has struggled since the introduction of two parasitic mites to the US in the mid 1980's. The introduction of the Tracheal Mite (*Acarapis woodii*) and Varroa mite (*Varroa descructor*) has nearly elimintaed the feral (wild) honey bee population in the US (Kraus and Page, 1995). The number of beekeepers managing honey bee colonies also declined due to the more complicated management requirements caused by the mites. In 1993, Michigan's Apiary law was changed to open the state for free movement of honeybee colonies as beekeepers sought to take colonies to southern states where they could better manage for mite control during the winter months. In recent years, Michigan beekeepers have moved bees to California for almond pollination, Florida for pickle pollination and to Maine for blueberry pollination. Michigan has become a migratory beekeeping state.

The Michigan Department of Agriculture provides inspection service to beekeepers needing a certificate of health for movement of their bees. However, because of the varied requirements for health certificates for movement, many of them voluntary, there is not a reliable estimate of the number of colonies moved into and out of the state each year.

Each spring, Michigan beekeepers return 32-35,000 migratory colonies of honeybees to Michigan from overwintering locations in Florida. Bees are known to return to Michigan from Georgia, California, and Texas, as well as other southern states. In addition, Michigan beekeepers obtain packaged bees, "nucs", and queen bees for the establishment of new colonies or to replace overwintered colonies that died for a number of reasons.

New Chapter-Bees *(continued)*
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Beekeepers now use an array of management tools, including miticides, antibiotics, and insecticides for the management of mites, the small hive beetle (Aethina tumida), brood diseases, and microsporidian parasites.

MANAGEMENT PRACTICES

Understanding some basic bee biology and beekeeping will facilitate your inspection of the hives, gauging of quality/strength of the hives, and help maximize the use of bees for your pollination.

Social Structure: Honey bees are social insects and only the sterile female workers do all the in-hive work (cleaning, drying nectar into honey, feeding young) and outside work (foraging for water, pollen, nectar and propolis, and colony defense). The queen's only job is to lay about 2,000 eggs per day and releases queen mandibular pheromone to let the workers know that she is present and healthy. The males' (drones) only job is to mate with queens and are produced only during May to August. A typical colony of bees has about 30,000 – 60,000 workers, one queen and a few to hundreds of drones. About 1/3 of these workers are foragers. Foragers show flower constancy so they tend to focus on flowers of a single species, resulting in more efficient pollination.

Internal Factors Affecting Foraging Behavior: To provide adequate pollination, honey bee colonies must be of sufficient strength, free of diseases and parasites, have a laying queen, and have adequate "brood" (immature stages which include eggs, larvae and pupae). A newly installed package bee colony, with 2 lbs of bees, would start with about ~9,000-11,000 workers and would not be considered ready for pollination work. Such a colony would concentrate heavily on brood rearing and only have about 1,000-2,000 foragers. Stronger colonies would send out about 30% of bees as foragers. A typical median strength over-wintered colony would have about 30,000 workers and can send out 10,000 foragers. With adequate resources, colonies can develop a work force of 60,000 or more workers at the peak of the season. Brood frames should be inspected for the presence of chalkbrood, American and European foulbrood, parasitic mites and symptoms of virus or other pathogens of honeybees. In general, 3-5 frames of solid brood suggest a fertile queen and a healthy colony. Bees should be periodically inspected for presence of Nosema disease.

External Factors Affecting Foraging Behavior: Environmental factors affect honey bee foraging. Bees do not work in the rain and work less on cloudy days. Foraging activity is positively related to temperature, with a linear relationship from 60-90°F. Foraging activity slows when it gets too hot (over 90°F). High winds (above 20 mph) will alter or inhibit flying activity, with bees choosing flight paths that are less affected by wind. As an example, honey bees placed for pollination of orchards will concentrate their efforts near the orchard floor under windy conditions, leaving the orchard crop poorly pollinated. By contrast, bumble bees can forage at lower temperature and

lower light conditions.

New Chapter-Bees *(continued)*
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Hive Density Recommendations: Because Varroa mites had wiped out most of our feral (wild) honey bee populations, recommended rates for pollination prior to 1987 have to be increased to compensate for the lack of "free" honey bees. The table below lists recommended rates for hive density. From an economic point of view, it is best to start with the highest number of hives you can afford, and then alter your hive count based on your observations. As new fruit and vegetable varieties are released, review pollination recommendations made by the developer, and then monitor pollination activity.

Table 1. Recommended density of honey bee colonies (per acre) for Michigan crops

Crop	Colonies	Notes
Apple	1-3	The more dwarf varieties need more hives
Sweet cherry	1	Balaton may need more
Pear, Plum, Peach	1	
Blueberry	3	Cultivars vary in their dependence on pollination
Cranberry	3	
Raspberry, strawberry	1	
Grape	0	Wind pollinated
Pickles (hand harvested)	1	
Pickles (machine harvested)	2-3	

One of the primary limitations to keeping bees is the real or perceived interaction between the bees and the people who live in or use the surrounding area. To overcome this problem, a hive density limit is proposed that minimizes potential conflicts between people and honeybees, assuming that beekeepers follow the management practices outlined in this document. (In the recommendations below, "undeveloped property" means any idle land that has no structures or facilities intended for human use or occupancy. Property used exclusively for streets, highways, or commercial agriculture is considered undeveloped property.)

Table 2a. Recommended density of honey bee colonies relative to lot size

Lot/Acreage	Number of Colonies
Up to 1/4 acre (1/4 acre=10,890 sq. ft., roughly 50 ft. x 215 ft.)	2
More than 1/4 acre, less than 1/2 acre (1/2 acre = 21,780 sq. ft., roughly 100 ft. x 218 ft.)	4
More than 1/2 acre, less than 1 acre (1 acre = 43,560 sq. ft., roughly 150 ft. x 290 ft.)	6
1 acre or more	8

New Chapter-Bees *(continued)*
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Table 2b. Recommended density of honey bee colonies regardless of lot size

Condition	Number of Colonies
If all hives are situated at least 200 feet in any direction from all property lines of the lot on which the apiary is situated,	No limit
As long as all adjoining property that falls within a 200-foot radius of any hive is undeveloped property	No Limit

Hive Placement: Correct placement of hives is an important consideration for responsible beekeeping in urban/suburban situations. Hives must be located in a quiet area of the lot, not placed directly against a neighboring property unless a solid fence or impenetrable vegetative barrier not less than six feet high forms the property boundary. Keep hives as far away as possible from roads, sidewalks, and rights of way. Hive entrances should face in such a direction that bees fly across your property. If this is impossible, use barriers (hedges, shrubs, or fencing six to twelve feet high) to redirect the bees' flight pattern.

Swarming: Swarming is a natural instinct of honeybees that occurs chiefly from spring to early summer. Swarms should be collected to prevent their becoming a nuisance. Honeybee colonies can and should be managed to prevent or minimize swarming. For example, brood chamber manipulation, colony division, adding supers for brood rearing and honey storage, and replacing old or failing queens can all reduce the swarming impulse. These and other management practices to control swarming are explained in detail in good beekeeping textbooks. Beekeepers who learn of a swarm should take reasonable measures to see that the swarm is retrieved.

Provision of Water: Beekeepers should assure an adequate source of fresh water for their bees prior to establishing an apiary. Where adequate fresh water from a nearby pond or stream is not available, beekeepers should establish a water source that will be available throughout the active flight season. Bees prefer a sunny place where they can gather surface moisture, for example wet sand or gravel or the edge of a birdbath. If you establish such water sources, your bees will become habituated to them and will be less likely to visit swimming pools or hot tubs. Remember that in very hot weather, bees use a large amount of water to maintain temperature and humidity within the hive.

Queens: In most cases, European honeybees are considered gentle. When a colony exhibits unusually defensive characteristics (stinging or attempting to sting without provocation), or exhibits a frequent tendency to swarm, it is the beekeeper's duty to re-queen from European stock. Queens should also be replaced as they get older, or as they begin to fail to ensure that the colony maintains strong numbers of healthy brood.

New Chapter-Bees *(continued)*
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Robbing Behavior: When nectar is scarce, honeybees may rob honey from other hives. Under such conditions, beekeepers should work hives for only a very short time, if at all. Exposing honey (especially sticky honeycombs) outdoors often encourages robbing. All spilled honey should be cleaned up immediately. To prevent robbing, buildings and trailers used for honey extraction must be made bee-proof, as far as is practicable.

Transportation of Hives: Beekeepers must take appropriate care when transporting hives of honeybees. All loads of hives and supers of honey should be secured. Bees being transported should have entrance screens or be secured under netting.

Recommendations for Considerate Hive Management: Beekeepers should take into account that weather conditions influence bee behavior and plan to work bees when conditions are favorable. They should make sure that neighbors are not working or relaxing outdoors when they open hives and should try to perform hive manipulations as quickly as possible, with minimum disturbance to the bees. Extended hive manipulations, particularly removing honey, should be carefully planned to accommodate neighbors' activities. Beekeepers should use smoke when working bees and should smoke hive entrances before mowing or trimming in the hive area. Clippings and exhaust should be directed away from hive entrances.

Adherence to the following list of beekeeping and apiary management practices will help beekeepers avoid conflicts with neighbors and demonstrate good beekeeping management:

1. Situate hives away from lot (property) lines and occupied buildings.
2. Locate hives away from roads and areas frequented by pedestrian and animal traffic.
3. In populated areas, uses fences and hedges as screens to conceal hives and to elevate the bees' flight path. Vegetation and fences also serve as windbreaks.
4. Do not situate hives on or next to utility right- of -ways (power lines, pipelines or underground cables).
5. Avoid placement of hives near schools, recreation areas, picnic grounds or other locations that may result in adverse honey bee/public interactions.
6. Provide a water source so the bees don't fix on neighborhood swimming pools, birdbaths, livestock/pet water sources, etc. The water source must be established before the weather gets hot so the bees are trained to it. Provide fresh water on a regular basis.*
7. Keep no more than 4 hives on a lot less than ½ acre.

8. Maintain gentle colonies. If hives become defensive, determine the cause and requeen with gentle stock if necessary. Skunks are often the reason for hives to suddenly become defensive.
9. Work bees when neighbors are not in their yard. Minimize robbing behavior.
10. Manage hives for swarm prevention.
11. When mowing the grass in front of hives, direct the clippings and exhaust away from the entrance.
12. Give your neighbors some honey or a pair of beeswax candles each year and share your enthusiasm and knowledge of beekeeping with the community.

Common water sources include birdbaths, pebble filled sections of gutter with end caps, plastic wading pools and entrance feeders. Pieces of carpet screen stapled to wooden frames, styrofoam floats, and stones and pebbles provide ample footing for the bees to prevent drowning. The addition of salt (water softener, pickling, and sea) or sugar often aids in the training process of honey bees.

HEALTH CARE

Disease Control: There are a number of honeybee diseases and pests, of which American Foulbrood (AFB) is the most serious. Other brood diseases, including European Foulbrood, Chalkbrood, Nosema, and viruses must be considered when caring for honeybee colonies. Beekeepers should be extremely cautious about mixing hive equipment or purchasing hives from sources that are not certain to be disease-free. Finally, it is incumbent on beekeepers to manage parasitic mites and other pests responsibly for both colony health and honey quality.

Pest Management during Pollination: Always make growers mindful that honeybees are active on their farm and that they need to follow appropriate practices to protect your honeybees. The use of broad-spectrum insecticides when flowers are open should always be avoided. Pesticide labels, as well as precautions regarding honeybee toxicity to a pesticide or combination of pesticides should be heeded by growers.

Bee hives should be removed immediately after pollination if post-bloom pesticide applications are planned. By monitoring for pest problems carefully during bloom, growers can help minimize the need for pest control. If an insecticide application is necessary during bloom, the compounds that are least toxic to bees should be used, with careful observation of the pollinator-restrictions on the label. If an application is required, the beekeeper should carefully determine whether the bees need to be moved prior to the application event.

New Chapter-Bees *(continued)*
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In general dusts, wettable powers and emulsifiable concentrate formulations are more harmful to honey bees. Applications conducted in the morning or daytime are not as safe for bees as evening applications. Ask the grower to inform the beekeeper before a spray so that colonies can be moved or shut down for 1-2 days with wetted-burlap blocking entrances, especially if highly toxic insecticides have to be used. This database lists the toxicity of various pesticides to honey bees: http://apiculture.com/databases/pesticides.htm.

Our appreciation to the Maine State Beekeepers Association for allowing us to use their excellent material in this document. Their full document can be seen at mainebeekeepers.org.

DEFINITIONS

Apiarist and beekeeper: A person keeping bees

Apiary: A place where honeybee hives are kept

Apiculture and Beekeeping: The management of beehives

Bee sting: Injury sustained and inflicted by a worker honeybee

Beehive: Removable framed housing fro a honeybee colony

Brand: Identification for marking frames and hives

Flight path: The distinct route taken by many bees leaving from or returning to their hive

Foraging bees: Bees seeking water or food - Bees naturally forage flowers for nectar and pollen. In abnormal circumstances, when natural sources of food and water are scarce, bees may forage supplies of animal feed, water or protein.

Hive: A honey bee hive, being a nucleus colony or a standard size colony

Honey extraction: The removal of hey from combs

Honey flow: The gathering of nectar from flora by honeybees

Honeycomb: Removable frames, containing wax cells which house honey, pollen, and/or brood (eggs, larvae, pupae)

Package bees: A number of adult bees, with or without a queen, contained in a ventilated shipping cage transported via USPS or other carriers

Pollination: The transfer of pollen by honeybees from anthers to stigmas of flowers for the purpose of plant fertilization

Robbing: Bees attempting to access honey stored or spilled in another hive

Strong hive: A populous honeybee colony

Super: Box or boxes containing frames placed above the bottom or brood

Swarm: Cluster of flying mass of honeybees including workers, queen, and drones

Water supply: Taps, hoses, pools, hot tubs, streams, ponds, puddles, etc.

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